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ABSTRACT

Various eye problems and the effects they can have on children's reading abilities are explored in this pamphlet, which is one of a series designed to answer parents' questions about their children's reading development. Topics discussed are the demands on vision made by reading, problems that affect visual acuity (nearsightedness, farsightedness, and astigmatism), problems that result from refractive differences (double vision, crosseyedness, walleyedness, and accommodation), color blindness, identifying visual problems (symptoms and vision screening), and what parents can do in regard to their children's vision. An annotated bibliography of two books is provided, six reference books are listed, and questions for thought and discussion are included. (JM)

How does my child's vision affect his reading?

She squints a lot, but she loves all the things she sees. She is happy looking at her friends and her books; she doesn't even realize that she can't see them as well as other people can. And her parents don't either. So the problem goes uncorrected. Do you know how well your child sees?

Normal visual development is important to reading.

Normal visual development. Your child's present vision, good or bad, has been developing since birth and will continue to develop until adulthood. At birth a baby's eyes move aimlessly. There is no apparent coordination between the two eyes, and vision is extremely poor. It isn't until he is about four months old that he can temporarily hold his eyes on an object. At about six months he can follow a moving object, and he can concentrate his attention on a fixed point by nine months. At this time he becomes inquisitive, reaches for things, and touches and examines them. He starts to appreciate objects beyond his reach at about eighteen months as his visual acuity improves to about 20/100. (He can see at a distance of

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by Donald W. Eberly

1972

20 feet what you see equally well at 100 feet.) At this time his ability to focus improves.

By two years his acuity has improved to about 20/70; he has become aware of details in the periphery of his vision; and he is beginning to use both eyes visually as a single unit. During the next few years his visual acuity and visual coordination improve so that at about six years of age he has reached a "normal" visual acuity of 20/20 and is able to use both eyes together as a single-seeing unit (Worth and Chavasse, 1959).

Reading makes demands on vision

At approximately this time, the child is introduced to reading, and greater demands are placed upon his visual sense. In fact, eighty percent of what he learns in school will come to him through his vision. Hopefully over the first five years of life he has had enough opportunities and experiences to adequately develop his visual skills. But if his visual experiences have been limited or if visual development has been slower than normal, the demands of reading may be more than his visual system can handle.

Generally, these demands include the following visual skills:

1) Clear single vision. Each eye must be able to see clearly and efficiently at different distances and over extended periods of time, ranging from approximately fifteen minutes for a six year old to several hours for an adult. This means that the eye's accomodative ability must be well developed so that the child can shift his visual attention quickly and effortlessly from his book to the blackboard and back to his book while maintaining clear single vision.
2) Integration of the vision of both eyes into one single image. Your child needs to be able to see as one image what each eye sees separately, and he must do this efficiently and smoothly both near and at a distance.
3) Coordination of eye-movements. Besides integrating the eyes so that one image is created from two separate images, your child needs to maintain this singleness as his eyes move from left to right while reading. These movements must be smooth and effortless for extended periods of time.

Obviously all reading problems are not the result of visual problems. In fact, a visual problem does not inevitably cause a reading problem. Some children seem able to compensate for their problems but others are not. And since reading is heavily visual in nature, visual defects usually do hamper a child's ability to read.

Problems that affect visual acuity. The best-known visual problems are those which affect visual acuity. Good acuity (clear vision of an object) depends on the light rays which hit the retina (a layer of cells sensitive to light) at the back of the

eye. The retina detects the light patterns and sends nerve messages to the brain which result in what we call sight. When a child looks at an object, light reflected from that object enters the eye, and the straight line path of that light is called a light ray. For an object to be seen clearly, the light rays coming from one point on the object (parallel light rays) should focus at one point on the retina. If the parallel rays entering the eye do not focus exactly on the retina but focus behind or in front of it, the result is a blur instead of a point.

The focusing of the light rays is due mainly to the shape of the cornea (the front of the eye), the shape of the lens (the part of the eye which changes curvature to bring about clear vision at a distance or near), and the length of the eye. Common problems which affect visual acuity are nearsightedness, farsightedness, and astigmatism.

Nearsightedness. Nearsightedness (myopia) or the inability to see clearly at a distance is relatively uncommon at birth. But as children grow older and as their bodies change physically, increasing numbers of them become nearsighted. By the high school years five to fifteen percent are affected, and in college some twenty to forty percent are myopic. Usually myopia begins sometime between the ages of 10 and 14 when the eye is growing rapidly along with the rest of the body, and it increases in severity until age 17 or 18 when it tends to stabilize. The degree of nearsightedness depends upon the age set; thus the earlier the occurrence, the more nearsighted

The nearsighted child sees his book clearly at close range (above), but the teacher and the blackboard are blurred. Light rays pass into the eye of a nearsighted person (below) and come to a focus (F) short of the retina (R).

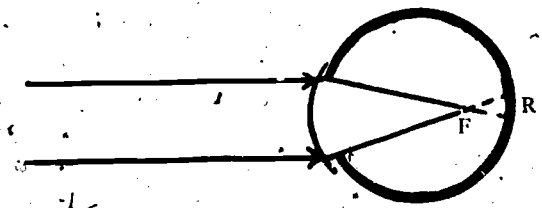


fig. 1

the child is likely to become; the later the occurrence, the less nearsighted (Young, 1965).

In general, nearsightedness occurs if the eye is too long. It can occur to a lesser extent when there are variabilities in the shape of the cornea and the lens. If the eye is too long, parallel rays of light which enter the eye come to a point in front of the retina, thus giving a blurred image. If the individual accommodates (or refocuses the lens of the eye), the point of focus will move forward, away from the retina, and the image will become more blurred. Only correction with glasses or contact lenses will enable the rays of light entering the eye to fall properly on the retina.

Quite often a nearsighted child will complain of not being able to see clearly at a distance. He may have trouble seeing words on the blackboard at school or distant signs while riding in a car. If he develops the problem early in life, he may fail to recognize his limitations and believe that blurred targets at a distance are normal. Also, he may tend to spend more time in school activities such as reading or drawing because he can see better at close range, while he may have difficulty with and tend to avoid activities such as basketball or football because they require good distance vision. Although there is a good chance that the child, a playmate, a member of his family, a teacher, or a nurse will notice the problem and seek treatment for him, the weeks, months, or years that elapse before

remediation is sought can have long-lasting detrimental effects on the child's school progress.

Farsightedness. Farsightedness (hyperopia, hypermetropia) or difficulty in maintaining clear vision at a short distance, especially at reading distance, can handicap a young child who is learning to read. At birth the majority of children are farsighted, but as they grow older, they become less farsighted.

When farsightedness is severe, everything is blurred, but when it is moderate or minor, vision appears normal. The reason for this apparent normality is that the farsighted child can compensate for his problem for short periods of time. Usually his eye is too short, and parallel rays of light which enter come to a focus or point behind his retina. By refocusing the lens of the eye, he is able to bring the image up to his retina and obtain clear vision. Unfortunately this readjustment, depending upon the severity of the farsightedness, cannot be maintained for extended periods when reading. It involves contracting muscles and keeping them contracted like lifting a brick and holding it motionless at shoulder height in one hand. A sense of confusion and a temporary blurring of vision may be experienced, and if the child is reading, the letters may seem to run together. Sometimes the eyes become tired and the child gets sleepy, making continued attention difficult or impossible. Looking away from the book at any distant target, such as the blackboard, classmates, or something out the

The farsighted child's eyes will become tired and strained under the tension of focusing clearly on close objects (above). Light rays enter the farsighted eye (below) and fail to come to a focus (F) by the time they reach the retina (R).

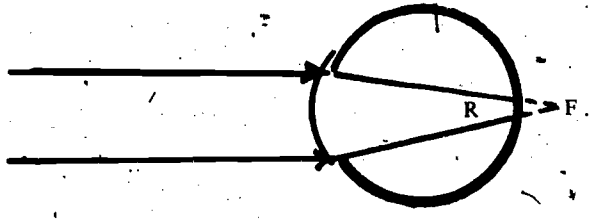


fig. 2

window, brings temporary relief, but the problem reappears when the child returns to reading, and it may cause him to give up from annoyance or exhaustion (Duke-Elder, 1965).

Sometimes the farsighted child finds it more agreeable to spend most of his time in outdoor activities and sports rather than in reading and near work because of his visual condition.

Farsightedness is a greater problem in reading than nearsightedness, and it is harder to detect. The commonly used school vision testing device, the Snellen Chart, is not effective in identifying children who are farsighted. Since they can see clearly for a short time, many can easily pass this test which requires clear vision for only seconds or minutes. Also, the test is given at a distance of twenty feet which is easier for a farsighted person to handle than the eight to fourteen inches, which may be his reading distance. The farther away the target is the less the lens must accomodate to produce clear vision, thus a closer target creates more stress.

If the child, parents, or teacher realizes that there is a visual problem, remediation can be accomplished in the majority of these cases with proper glasses or contact lenses. However, identification may be difficult because the child can see well for short periods of time.

Astigmatism. Unequal curvature of the cornea (astigmatism), which causes rays of light to fall at different distances from

Astigmatic conditions can create blurred vision for your child.

the retina, appears to create more reading problems than nearsightedness but fewer than farsightedness. A certain number of children with this problem will be noticed by school testing methods or by parents because of their obvious symptoms. If the condition is severe enough, blurred vision occurs, and the child squints to see better. Other children must continuously accomodate to see clearly; therefore, they experience visual discomfort or eye strain as with farsightedness. This is particularly true when small astigmatic errors are present. While some children are able to adequately compensor the problem, others develop identifiable symptoms such as headaches, dizziness, irritability, fatigue, or nervousness. In many cases astigmatism is associated with problems of nearsightedness or farsightedness, and usually it can be corrected with glasses or contact lenses.

Problems that result from refractive differences

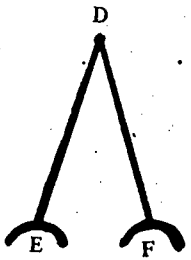
However, these problems don't always affect both eyes to the same degree, and when the two eyes are considered together, unique problems may occur. One such problem results from refractive differences between the eyes as with an extremely farsighted left eye and a moderately farsighted right eye or a normal left eye and an extremely nearsighted right eye.

Double vision. Even though each eye may be normal or corrected to normal so as to obtain clear single vision, when the two eyes are brought together to view the same target, complications can occur. For example, the correction may result in the two eyes seeing different-sized images. If the conflict between the two eyes is great enough that double vision (diplopia) occurs, the child may be forced to alternate, viewing the target with one eye and then the other, or he may find it easier to suppress the vision of one eye and use only the other. This type of problem is often missed by a school screening test like the Snellen because it does not consider what happens when the two eyes are used together. And both must work well together for efficient reading. There are various ways in which the problem can be handled. Sometimes

not fully correcting one eye and then increasing the power of the lens over a period of time allows the eyes to get used to the difference and maintain a single image. Another method is visual training.

Crosseyedness and walleyedness. Turning the eyes inward to observe a near target such as words on a page (convergence) can also create problems. Normally the eyes look straight ahead at distant targets and will turn in as the target comes nearer. Sometimes, as in farsightedness, overconvergence occurs; at other times, as in nearsightedness, underconvergence is observed. If either type of convergence is too great, stress situations which lead to double vision can develop. In overconvergence one eye may turn in so far that it results in crosseyedness. In underconvergence one eye may turn out so much that it results in walleyedness. Sometimes these convergence errors appear only when the child is very tired, as after prolonged reading; at other times the eye may stay either turned in or out constantly. Quite often this occurs before the child enters school and is the first sign of a visual problem. Although it has been said that children outgrow such defects, this is usually not the case. And early remediation, such as lenses, visual training, and/or the patching of an eye, increases the chance of success. Therefore, it is not wise to wait.

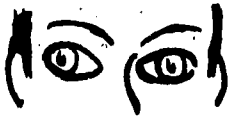
A walleyed or crosseyed child may experience two images, one of them out of focus.



Convergence

D: Target
E: Left eye
F: Right eye

G: Crosseyedness



H: Walleyedness

Accommodation. When convergence is considered, refocusing of the lens (accommodation) must also be taken into account. When the eyes converge and change from looking at a distant target, such as the blackboard, to looking at a child's reading material on his desk, accommodation has to take place to

ensure that the target viewed remains clear. The lens of the eye changes its shape so that the front of the lens becomes more or less curved, depending upon the distance at which the target is viewed. The interaction between the child's accommodation and convergence can cause a difficult situation. The relationship between these two processes may be normal at a distance but abnormal near. Other times it may be normal near but abnormal at a distance. Sometimes it is even normal at a distance and near but abnormal at some intermediate distance. Once again, the proper lenses and/or visual training can be implemented in many cases to reduce visual stress and to improve a child's visual efficiency.

Another important aspect of vision is the amplitude of accommodation (the nearest position a target, such as printed material, can be brought to a person's eye before the image blurs). Children can usually bring a target extremely close to their eyes before it blurs. However, as they get older the position starts to move away, and adults of 40 to 50 years of age may have to wear bifocals because of their inability to see near targets. If there is a difference in refractive ability between the two eyes, the nearness at which print blurs may differ between the two eyes. For a six-year-old child it may be within two inches of one eye but within five inches of the other. If the child reads with the book quite close to his face, a practice which is not unusual for many children, fatigue and visual stress may occur.

Many of these conditions by themselves cause no apparent problems. However, when minor problems are combined such as moderate underconvergence and moderate nearsightedness, or overconvergence, accommodation, and moderate farsightedness, the combined effect may be more than the child can handle as he tries to meet the visual needs of a typical school day. Visual demands increase as he progresses, and what may be no problem in grades one and two can become an insurmountable problem in grade three.

Color blindness

Defective color vision can also create a learning handicap. Approximately eight percent of all males and one-half of one percent of all females are color defective to some degree. The problem is that over half of this group are unaware of their color deficiency. Basically the person who is color blind or who has defective color vision is unable to respond to all the wave lengths of visual light; he sees a smaller number of colors than the normal observer. The individual with normal color vision can make appropriate color matches by combining the three primary colors—red, blue, and yellow—(Heath, 1963). Some color defective persons may be able to match all colors of the spectrum with a mixture of only two colors; they are called dichromats.

In "red-blindness" (protanopia) the individual has difficulty

discriminating between red, dark-brown, and black, and also between green and fawn. In so-called "green-blindness" (deuteranopia) the individual has difficulty discriminating between red, orange, and green, while magenta and purple tend to look gray (Dvorine, 1971).

In total color blindness the individual cannot perceive any color and thus sees only variations of black and white. His world looks like a black and white television picture. This is a much rarer type of color blindness, with about one in ten thousand persons being affected.

Since special tests are required to detect color blindness and since school screening tests very rarely check for this problem, many color blind children and adults are unaware of their deficiency. Because of the extensive use of color in books, classroom materials, displays, and other school-oriented things, children with defective color vision can be handicapped in many experiences which are taken for granted by their classmates. Teachers, parents, and fellow classmates are sometimes intolerant of children who have color problems if all of them are not aware of the real handicap. An art teacher may think a child is lazy or a troublemaker because he uses the wrong colors in his painting or drawing. A parent may disapprove of his child's wearing different colored socks or clothes which are conflicting in color, and classmates may laugh at these inappropriate choices. Obviously, there are ways in which a child can be psychologically hurt because of an unrealized color deficiency. Even though there is no way to correct or remediate defective color vision, awareness of the nature of the problem can make the child's life much more pleasant.

Identifying visual problems

In fact, awareness is vital for all visual problems, and there are many ways that you as a parent can help your child identify and cope with visual deficiencies. You can begin just by watching. Depending upon the severity and type, you may or may not be successful in identifying all problems; however, the following symptoms, if they persist, are fairly common indicators of some type of visual deficiency.

Symptoms. Children may complain of headaches, dizziness, blurring of near or distant targets, and sensitivity to light. The eyes or eyelids may have an abnormal appearance; sties or squinting or scowling may be frequent. An eye may turn in or out persistently, or a lack of coordination of the eyes may be apparent. The child may rub his eyes frequently, lean forward or tilt his head backward, turn his head to one side, or cover or shut one eye. He may become excessively irritable or inattentive when doing extended near work such as reading.

It is well to recognize, however, that these symptoms are only possible indications of visual problems and should be considered as such. They can be caused by something other than

poor vision. But if you notice one of them or anything else which seems unique to your child's visual behavior, it is wise to keep track of how often the symptoms occur. Regardless of the cause, frequency and time of occurrence tell you much. In the case of vision, they help avoid incorrect diagnoses of "problems" that don't really exist. For example, a playmate may get glasses or blink a lot, and your child will begin saying he has trouble seeing or he will begin to blink frequently too. Many times what appear to be serious symptoms are really transitory and go away in a few days. If the child's symptoms do persist, however, it is a good idea to ask the child's teacher if she has noticed any problems, to request that the school nurse test the child, or, best of all, to have a vision specialist give him a complete eye examination.

Vision screening. Another way to insure that your child sees well is to be aware that receiving a note from school which indicates that your child failed or passed a vision screening test can mean several things. The screening instrument will have a great effect upon whether a child passes or fails. As noted before, the Snellen chart catches slightly less than one-half of all vision problems so that many children are passed who should have been failed and referred for possible treatment. Other tests such as the Massachusetts Vision Test, the Telebinocular Vision Test, the Orthorater, and the Professional Vision Tester (Titmus) tend to catch and refer more children with eye problems, but these instruments also have a tendency to refer children who are subsequently found to be normal.

The optimal screening technique at the present time is the Modified Clinical Technique in which professional vision specialists carry out a testing program in the school. This program is extremely accurate in identifying children who really have vision problems. Also the cost to the community in implementing such a program is actually less than any of the other available programs. Unfortunately, too few schools have taken the opportunity of implementing this program, and a slip from school saying that your child has passed the school vision screening test still can be misleading.

What parents can do

Because of these limitations, much of the responsibility for insuring that your child has the best possible vision as he progresses through school rests with you as a parent. And the responsibility begins early. Vision is extremely important in the years when the preschool child is learning those things which will become the framework for later experiences in life. It is also vital in the primary grades when learning to read places a tremendous visual stress upon him. If he doesn't have effective vision, he may suffer damage both scholastically and psychologically. He may do poorly in his school work, and he may get the wrong impression of himself. He may even decide that school is not for him and that he can never do well— all because he cannot see clearly or adequately compensate for a visual problem.

Obviously good vision does not guarantee school success nor does poor vision preclude it, but growing up is hard enough for most children; there is no need to put unnecessary difficulties in their way. Much poor vision is just such an obstacle which may be corrected by proper glasses, visual training, or other remediation. If the visual problem is one such as color blindness which cannot be corrected, awareness of its existence allows parents and teachers to help the child rather than to blame him. So if possible, have your child's vision thoroughly checked by a vision specialist before he goes to school, and at other times, if you have reason to suspect that he has a vision problem.

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Some Questions for Thought and Discussion

How does a child's vision develop from birth to six months, to nine months, to two years, to six years?

What are the basic demands that reading makes on your child's eyes?

What are some of the indications of possible nearsightedness that a parent might notice? How can nearsightedness be corrected?

What are some of the indications of possible farsightedness that a parent might notice? How can farsightedness be corrected?

Why is farsightedness more difficult to identify as a vision problem than nearsightedness?

What causes astigmatism? What kind of problems can it give a young reader, and how can they be recognized? How can astigmatism be corrected?

How are convergence and accomodation interrelated in consideration of accurate vision?

What colors do children who are colorblind have difficulty with? Why is it important that children with any of the three kinds of colorblindness be identified?

Why is the frequency with which symptoms of visual problems occur especially important for the parent to notice?

What provisions are made in your schools for testing vision and at what levels? How is a vision problem referred when detecting by testing or by a teacher?

How do these terms relate to vision problems?

1. single vision
2. integration of vision
3. coordination of eye movements
4. visual acuity
5. the cornea
6. the lens of the eye
7. the retina
8. myopia
9. hyperopia or hypermetropia
10. astigmatism
11. diplopia
12. convergence
13. accomodation
14. walleyedness
15. protanopia
16. deuteranopia

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